The Pedagogical Opportunities of Technical Standards: Learning from the Electronic Product Code

By Jordan Frith

ABSTRACT

Purpose: The goal of this article is to make the case that technical standards can be valuable educational tools for technical communication teachers. The article argues for the pedagogical value of standards through an examination of one particular standard: the Tag Data Standard, published by GS1. The analysis focuses on areas in which the document could be improved by technical communication practitioners and students.

Method: The data for this article come from the 126-page Tag Data Standard. The standard was inductively analyzed using grounded theory and involved a second coder. The research question that guided this analysis was, "How could this comprehensive standard be improved by trained technical communicators?" The goal is to show how technical standards could be used to provide students with real-world texts to analyze and edit.

Results: The data show the TDS could likely be improved if technical communication practitioners were more involved in the writing process to focus on issues of consistency, audience, and design. The article uses those results to show why standards could be valuable educational tools for teachers.

Conclusion: Standards are a crucial form of technical communication. They are an example of how language shapes the material world. The analysis in this article shows that these crucial documents can be improved by skilled technical communicators and can serve multiple pedagogical goals, including showing students how documents shape materiality and providing students with comprehensive, real-world texts to work with and improve.

Keywords: documentation, pedagogy, standards, technical writing, infrastructure

Practitioner's Takeaway:

- Technical standards are important forms of technical communication.
- Standards are a valuable teaching tool for showing students how texts affect technologies.
- Standards are also publicly available documents teachers can use in the classroom as real-world editing opportunities.

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INTRODUCTION

Technical communication often involves writing that supports other operations. Practitioners document software processes, report on user research that influences product design, and strategize content governance. Their work plays a crucial but sometimes unnoticed role in shaping practices across a range of technical artifacts. This article focuses on a different type of technical communication that plays a consequential role in how language shapes the material world: technical standards.

Technical standards have not been a major focus in technical communication research or pedagogy, but this article argues they should be. Technical standards are documents that dictate how materiality is shaped. They prescribe the distance between studs in a house, how contactless payments communicate between card and reader, and how food safety is managed. Behind all of these practices are documents published through various standards organizations, including the International Organization for Standardization (ISO), the GS1, and the World Wide Web Consortium (W3C), to name just a few. These organizations publish specifications designed to work across industries. For example, the IpV4 and IpV6 standards developed by the Internet Engineering Task Force make it so that devices, regardless of manufacturer or ISP, are assigned similarly structured IP addresses (Hinden, 1995). Without a broader industry standard, the Internet would not be able to work as it does. The same applies to many other standards. For example, the Universal Product Code (UPC) and International Article Number (EAN) are what make barcodes interoperable across millions of retail sites (Brown, 1997). Without those standards, much of the global retail economy would not be possible.

These standards are examples of technical communication, even if they have not been a significant research focus in the major technical communication journals. Consequently, this article builds two arguments. The first is that standards should be considered as technical communication and should be an object of research within the discipline. The second argument is that technical standards can be valuable pedagogical tools in the technical communication classroom. Technical standards offer an opportunity to teach students in concrete ways about how written language shapes the material world. They are also living documents that are publicly available for students to analyze and comprehensively edit to gain hands-on experience with real technical texts. Finally, as the article argues, standards are examples of technical communication students should be trained to write and interact with. Teaching familiarity with standard-writing open up opportunities for employment with various standards-setting bodies.

To make the case for standards playing a more significant role as both an object for research and as a pedagogical opportunity for technical communication instructors, I begin the article by discussing what standards do and the major organizations involved in standards setting. I then discuss technical standards research published in the five major technical communication journals; as I show, the discipline has not focused much on standards as texts, and there is little research I am aware of that treats standards as potential pedagogical opportunities. After the literature review, I then discuss the methods and the data analyzed for this study: the 126-page Tag Data Standard that is a key standard in the Internet of Things. The research question that guided the analysis was, "How could this comprehensive standard be improved by trained technical communicators?" with a specific focus on areas in which the text could be improved as part of a larger classroom comprehensive editing project. The goal of the analysis is not to critique the standard under study, but rather to make two cases: 1) Standards are technical communication that can be improved by trained practitioners, and 2) These texts can be valuable teaching tools because they are technical texts that show how written language impacts the shape of technologies across industries.

Although those two goals are distinct, they are also linked. While the actual job of standards-writer is specialized and tends to be populated by higher-level technical communicators, many novice and mid-level technical communicators must be familiar with how to write to or design for specific standards. Consequently, although only a small fraction of technical communicators will be responsible for writing standards, the ability to deal with inconsistencies within existing standards can help students prepare for using standards in the workplace. Even more broadly, the examination of standards in the technical communication classroom provides students with opportunities to work with real-world technical texts in a genre they will likely have to deal with in their careers. And, as a final point, unlike many proprietary technical documents, standards are widely available to teachers, so I conclude with a discussion section that includes resources technical communication instructors could use to further develop pedagogical approaches to the study of standards.

UNDERSTANDING STANDARDS

The most straightforward but necessary point to make about standards is that they are important. As sociologist Lawrence Busch (2011) argued, they "are about the ways in which we order ourselves, other people, things, processes, numbers, and even language itself" (p. 3). They remain mostly out of view, but they become the discursive scaffolding that separates in-groups (those that conform to widespread standards) from out-groups (those people and things that do not follow standardization) (Bowker & Star, 1999). An object's ability to conform to a technical standard is a test to "determine what shall count. Those people and things that pass the tests or make the grade are drawn into various networks" (Busch, 2011, p. 12). The object either conforms to the written language of the standard or it cannot enter the networks of standardized objects moving through the world.

Technical standards also include some combination of various elements, including *standard specifications*, *standard test methods*, and *standard definitions.* Those areas are covered by the definition of technical standards used by the U.S. government:

- "Common and repeated use of rules, conditions, guidelines or characteristics for products or related processes and production methods, and related management systems practices.
- The definition of terms; classification of components; delineation of procedures; specification of dimensions, materials, performance, designs, or operations; measurement of quality and quantity in describing materials, processes, products, systems, services, or practices; test methods and sampling procedures; or descriptions of fit and measurements of size or strength" (OMB Circular No. A-119, 2016, p. 5).

That definition shows the varied nature of technical standards and also how they fit within technical communication more broadly. A typical standard might include sections focusing on technical definitions, instructional material, and test procedures for evaluating a product or practice. Much of the content involves translating complex material from the standards-setting bodies to diverse audiences interested in implementing the standard. And, importantly, standards are often fairly technical documents that, according to the German Institute for Standardization, "are not written for the general reader – anyone using standards should have enough technical knowledge that they can take reasonable responsibility for their actions" (Schmidt, 2018, n.p.).

Standards also serve a rather unique place in the various technical documents engineers must interact with because standards are different from legal regulations. There are various laws that determine forms an object must take. For example, California has emissions regulations vehicles must meet to be legally operable in the state. Most countries have safety regulations for objects; for example, cars must meet certain safety minimums to be sold in the European Union. As far as digital media goes, the General Data Protection Regulation (GDPR) in Europe dictates what information companies can and cannot collect about individuals, so, in a sense, the regulation shapes the structure of information collection. However, as AEM Senior Director Michael Pankonin (2016) points out, despite much confusion, legal regulations are not the same as standards. Laws and regulations do partially shape how objects work, but they do so in different ways from technical standards.

Unlike laws and regulations, standards are not legally binding. The ISO, for example, has thousands of standards companies are encouraged to follow, but companies do not have to follow them. The same is true for almost all standards-setting bodies. GS1 dictates standard data formats for barcodes and Radio Frequency Identification (RFID) tags, but other companies are free to not participate and design their own data format (UPS is one company that does so). The World Wide Web Consortium (W3C) sets accessibility standards for Web pages, but companies do not face legal consequences if they do not conform to the W3C. These standards are not completely separate from law because, as the former secretary general of the United Nations Kofi Annan argued, many lawmakers do consult standards when determining new laws (Bird, 2004). But, regardless, standards serve a different rhetorical function from law and regulation, and as the German Institute for Standardisation explains, “Unlike laws, standards are not legally binding. Their use only becomes binding when this is stipulated in legislation or in a contract” (Schmidt, 2018).

So if standards are not legally binding, what do they do as technical documents? The answer is that they serve a variety of functions.

- They can improve consumer confidence because consumers can be fairly sure that products that followed agreed-upon standards are “are safe, reliable and of good quality” (ISO, 2018, n.p.).
- They can protect manufacturers from legal liability. German law, for example, dictates that “courts can use standards to determine whether a product is faulty and if the manufacturer is liable for damages” (Schmidt, 2018, para 2). Manufacturers that can prove they followed established standards will likely not be found liable for damages.
- They can help new technologies thrive. For example, a study of RFID adoption in retail found that the creation of an industry-wide tagging data standard increased adoption (Beck, 2018). Because of the standard, companies could more easily adopt RFID because they knew tags from different manufacturers would be interoperable.
- They are infrastructures that make other infrastructures possible (Frith, 2019). For example, the Internet would not work without a variety of technical standards that determine how modems connect, the IP addresses assigned to objects, and so on. If each manufacturer used a different process, adoption would be much slower.

Because of their importance, this article argues that technical standards are both an important form of technical communication and that they can be valuable teaching tools in the technical communication classroom. Consequently, even for students who have no intention of going into standards-writing, these documents can provide opportunities to work with technical documents and become familiar with a genre they will likely have to deal with in the workplace. In addition, technical standards are real-world documents available to instructors, and the discussion section of this article provides a list of resources instructors can use to find available standards. Finally, for technical communication classes populated primarily by engineers, technical standard documents can familiarize students with the importance of how technical writing shapes the projects engineers work on in professional settings.

ACADEMIC TECHNICAL COMMUNICATION RESEARCH AND STANDARDS

To find technical communication research on technical standards, I searched for the term “technical standards” and then just “standards” in the five major technical communication journal identified by Lam and Boettger (2017): *Technical Communication, Journal of Business & Technical Communication, IEEE Transactions of Professional Communication, Technical Communication Quarterly,* and *Journal of Technical Writing and Communication.* I did not set a date range for the search because standards are not an emerging type of document; that is, research from the 1980s or 1990s would still be relevant to this study. The term “standards” returned some unrelated results, such as articles about white papers and articles about establishing guidelines for client work in the classroom. Consequently, I read through the returned articles to identify their relevance to research on technical standards.

The first point to make is that not much research has been published related to technical standards in technical communication journals. In addition, as far as my searches showed, little to no technical communication research has either treated technical standards as texts worth analyzing or technical standards as texts with pedagogical potential. The bulk of research that addresses technical standards in any detail focuses more on how they impact technical communication than the role technical communication plays in shaping them as texts. For example, Hackos published articles about how to develop technical editing standards (Hackos, 1985), how ISO standards can impact project management (Hackos, 2018), and why organizations need to implement standards, writing that “standards help the community demonstrate that it has people working together worldwide to ensure that it defines and implements best practices in designing content and delivering it effectively" (Hackos, 2016, p. 24). Relatedly, Batova and Andersen (2017) argued that content management professionals need to be familiar with industry standards.

A few research studies in technical communication journals did treat standards somewhat as an object of study. Haas and Witte (2001) performed ethnographic work to examine how engineers collaborate to write technical standards and focused on the embodied nature of writing. Their work with engineers showed that "the standards document, then, is meant to codify expert knowledge (much of it, as we illustrate, embodied knowledge), streamline decision making, and standardize the material reality of city infrastructure" (p. 419). Interestingly, while their work was published in the *Journal of Business & Technical Communication* and examined clear practices of technical communication, technical communicators were not the ones working on the standard. Instead, the process involved engineers and city planners.

The one study I could find in the five technical communication journals that discussed using standards in the classroom was Youngblood's (2012) examination of how to teach accessibility standards in Web design classes. Her work used standards as part of a pedagogical approach, but, in that case, the goal was to familiarize Web development students with the importance of accessibility standards. Consequently, this research study fills gaps in the literature in multiple ways. For one, it is one of the only technical communication studies to treat standards as technical texts worth empirically analyzing. Most importantly, this study uses that analysis to make the case for why technical standards should be used in the technical communication classroom. In particular, no studies have examined standards as texts that could be improved and analyzed as part of the process of teaching technical communication students (and practitioners interested in standards writing) how to deal with real-world technical material.

METHODS

The data for this study came from the Tag Data Standard (TDS) that governs deployment of the Electronic Product Code (EPC). The EPC is the data format used on RFID tags to identify items in the supply chain and is one of the major standards that has influenced the development of the Internet of Things (Ashton, 2009). The EPC works as an updated version of existing barcode data standards, and, because of the higher data capacity, the EPC has vastly expanded identification capabilities, with 2,541,865,828,329 possible numbering options. The document is published and maintained by GS1, which is a major standards-setting bodies that "enable organisations to identify, capture and share information smoothly, creating a common language that underpins systems and processes all over the world" (GS1, 2018, n.p.). The TDS is one of the most important documents published by GS1.

The TDS was chosen for this study because it is an important technical standard in business and logistics, is freely available, and is comprehensive enough to render a rich dataset. The technical standard is 126 pages with an extra 74 pages of appendices. The appendices were not included in this data analysis because they are not the body of the document. The version of the TDS analyzed for this study is 1.9, and since the larger research project began, the GS1 has published two more recent versions (the current version is 1.11). The changes are minor and affect only small parts of the document.

This study used a grounded theory approach to analyze the TDS as data. Grounded theory is an inductive method, and I used grounded theory because I wanted to approach the data with minimal theoretical preconceptions (Charmaz, 2006; Glaser & Strauss, 1967). Consequently, I began the study with a broad research question that guided my analysis: "How could this comprehensive standard be improved by trained technical communicators?" To answer that research question, I began by performing open coding to broadly identify areas of interest within the TDS. I used NVivo software to perform the coding. I then proceeded through seven full iterations of coding all the data to hone down the number of categories and identify relationships between types of content. The coding process also involved an extensive memoing process that described each category in full and explained linkages among categories.

Once I was comfortable with the categories I had identified in the data, I then met with a second coder to train her with the coding. She then coded the dataset independently and we came to an agreement on reoccurring issues that arose within the text of the TDS. Throughout the coding process, my second coder and I were guided by the overarching research question and coded the data to identify categories of content in which the standard could be improved through best practices of technical communication. The end goal was twofold: to examine roles technical communicators can play in improving technical standards and to show how established standards can work as real-world teaching documents that can be improved through classroom projects.

To fit with the tenets of grounded theory, I provide textual evidence of each category below. However, before moving on to the data analysis, I want to stress one main point: My second coder and I did not analyze the TDS as a critique of the document. The TDS is comprehensive, mostly well-constructed, and deals with technical material across a range of industries. The TDS also follows certain genre constraints, such as the use of passive voice, that might be in conflict with some technical communication practices, so I do not include categories that may conflict with genre expectations of technical standards. Rather, the focus was on identifying areas that could be improved by trained technical communicators with a specific focus on using technical standards as pedagogical tools. After detailing the data analysis, I return to the focus on pedagogy in the discussion and include resources instructors can use to find standards tools.

DATA ANALYSIS

The categories below identify reoccurring issues I identified in the TDS that corresponded to the guiding research question. To provide examples and fit with the tenets of grounded theory (Charmaz, 2006), the data analysis relies on researcher description as well as actual text from the document. The descriptions also explain how frequently such instances arose in the data and if the occurrences were spread throughout the document or contained in individual sections.

Inconsistencies with Authorship

Version 1.9 of the TDS does not identify any authors, though an earlier version (Version 1.1) identified the "Tag Data Standard Working Group" as the document's author (GS1, 2005). The title pages of the more recent version only lists GS1, which is the organization responsible for publishing the standard. Consequently, based only on the textual data, there is no way to definitively determine the authorship of the document. However, the analysis revealed an ongoing issue throughout the 18 sections of the document: inconsistency that suggests multiple authors who did not harmonize one voice for the TDS.

One example came in language used to identify particularly important pieces of text. As a comprehensive guide to EPC deployment, some pieces of the standard were likely more crucial to readers than other pieces. To get readers' attention, the TDS used a variety of linguistic markers, but the markers were inconsistent across sections. For example, a few of the common constructions were:

- "Note that" (coded in sections 5 and 6)
- "It should always be remembered" (coded in sections 3 and 4)
- "It should be recognized" (coded in sections 10 and 11)
- "It is essential to understand" (coded in sections 11 and 12)

As the list above makes clear, the language used to identify important pieces of the text was inconsistent across sections. The TDS did not have any linguistic markers used across more than 2 sections to help the reader identify key passages of text. Consequently, the lack of consistency could lead to confusion for readers who rely on linguistic markers to recognize key passages.

Another example of inconsistency came in the form instructions took in the TDS. Much of the TDS focused on instruction, and one of the document's main purposes is to instruct readers how to implement EPCs across various industries. The front matter of the document included definitions of how words such as SHOULD, SHALL, MAY, and so on should be interpreted within instructional content. However, while the front matter defined how these terms should be understood (at least when they are in all capital letters), the actual format instructional content took faced similar issues as the signaling language. As an example, sections 11, 15, and 16 clearly marked most instructional content with the word "Procedure:" followed by a list of numbered steps. None of the other 15 sections used that construction to denote instructional content: Section 19 shifted to bulleted rather than numbered lists, section 3 included all instruction in paragraph form, and section 8 included numbered lists but did not mark them with “Procedure:”.

The following three blocks of text contain three common presentations of instruction in the TDS. The constructions have little similarity, with one being numbered, one being bulleted, and one being in paragraph form.

Procedure:

1. Starting with the EPC Pure Identity URI, replace the prefix urn:epc:id: with urn:epc:tag:.
2. Replace the EPC scheme name with the selected EPC binary coding scheme name. For example, replace sgtin with sgtin-96 or sgtin-198.
3. If the selected binary coding scheme includes a filter value, insert the filter value as a single decimal digit following the rightmost colon (“:”) character of the URI, followed by a dot (“.”) character.
4. If the attribute bits are non-zero, construct a string [att=xNN], where NN is the value of the attribute bits as a 2-digit hexadecimal numeral.
5. If the user memory indicator is non-zero, construct a string [umi=1].
6. If Step 4 or Step 5 yielded a non-empty string, insert those strings following the rightmost colon (“:”) character of the URI, followed by an additional colon character.
7. The resulting string is the EPC Tag URI.

Output: Translate each 7-bit segment, up to but not including the first all-zero segment (if any), into a single character or 3-charcter escape triplet by looking up the 7-bit segment in Table A-1, and using the value found in the “URI Form” column. Concatenate the characters and/or 3-character triplets in the order corresponding to the input bit string. The resulting character string is the output. This character string matches the GS3A3 production of the grammar in Section 5.

Construct the output bit string by concatenating the following three components:

- The value P specified in the “partition value” column of the matching partition table row, as a 3bit binary integer.
- The value of C considered as a decimal integer, converted to an M-bit binary integer, where M is the number of bits specified in the “GS1 Company Prefix bits” column of the matching partition table row.
- The value of D considered as a decimal integer, converted to an N-bit binary integer, where N is the number of bits specified in the “other field bits” column of the matching partition table row. If D is the empty string, the value of the N-bit integer is zero.

The inconsistencies in method of instructional delivery were found throughout the document. One possible explanation may be the nature of the standard as a constantly evolving text. The original TDS specification published in 2005 contained 11 fewer sections in the body of the document and was 52 pages shorter with 8 fewer appendices. Different sections were added over time through the iterations of the document, which might explain some of the inconsistency found amongst the sections.

The issues with consistency are more than a simple copyediting fix. Lack of consistency can make it difficult for readers using the document to know when pieces of text are marked as important or even when pieces of text have transitioned from description to instruction. The focus on inconsistencies across sections provides students with the opportunity to better understand how living technical documents change through multiple iterations. The ability to identify the types of inconsistencies that often occur as multiple parties involved in document creation also enables opportunities to teach students about harmonizing voices in multi-author documents and have them identify areas of improvement through techniques such as structured authoring.

Lack of Audience Identification

The TDS has a clear yet varied audience. The front matter of the document includes the following section that defines that audience:

Audience for this document

The target audience for this specification includes:

- EPC Middleware vendors
- RFID Tag users and encoders
- Reader vendors
- Application developers
- System integrators

The explicit identification of audience in the front-matter, however, is the last time the word "audience" appears in the text. The issue with the document's lack of later mentions of audience is that each of those bullets has potentially different interests. The TDS is a comprehensive document devoted to:

- The specification of the Electronic Product Code, including its representation at various levels of the EPCglobal Architecture and its correspondence to GS1 keys and other existing codes.
- The specification of data that is carried on Gen 2 RFID tags, including the EPC, "user memory" data, control information, and tag manufacture information.

Consequently, not all parts of the TDS are relevant to the different audiences. For example, reader vendors design and market RFID readers and are likely not as interested in how data in integrated onto RFID tags. The RFID encoders, on the other hand, may be primarily interested in the different data structures. Breaking audiences down even further, the TDS includes highly specific sections on RFID deployment. For example, entire sections are devoted to encoding tags with data used by the U.S. Department of Defense. Other sections focus on publishers using ISBNs alongside EPCs. It is likely that no individual reader would be interested in using the entirety of the document.

The varied audience identified in the document and the comprehensiveness of the TDS suggest that a more extensive discussion of audience could help readers know which sections are applicable. But the document, as mentioned above, does not explicitly mention audience outside the front matter. In addition, many of the listed audiences in the front matter are never mentioned again. For example, there is no other mention of "reader vendors" or "application developers" in the 126 pages of text. Consequently, the TDS could benefit from a more fine-grained understanding of audience that includes information in each section about to whom the text is targeted. In its current form, readers are not given any guidance about which sections of the document are intended for the five different audiences identified in the front matter.

The issues of audience provide another opportunity for students working on suggesting comprehensive edits for the TDS. Audience analysis is a basic principle for technical communication, and students are often taught how to make audiences explicit within technical texts. As comprehensive, multi-section documents, standards provide an opportunity to have students identify primary and secondary audiences and make suggestions about how to incorporate that information into the text. The experience can also prepare students to work with standards in the workplace and understand that many comprehensive standards may only have small sections that are applicable to technical communicators.

Design Emphases and References

The TDS is a fairly consistently designed document. The sections and subsections are labeled with numbered headings. The tables and figures are numbered as well. The font choices remain consistent throughout. The layout is clear throughout the document.

Although the more major design elements of the TDS are all fine, the document uses few smaller design elements to guide the reader. There are no design emphases for important pieces of content and no subheadings used to identify audiences for specific sections. The only alteration in text comes in the different font used to differentiate data strings from the rest of the text. Outside of headings and a different font for data, the document does nothing to identify specific pieces of text.

Another issue is with appendices. The TDS has 14 appendices (A–N), but the body text only references five of the appendices (D, G, I, L, and M). The consequences of the lack of textual reference can be seen when looking at Appendix B: the Glossary. The glossary contains detailed definitions of 29 terms. Nothing outside the table of contents, however, alerts the reader to the existence of the glossary. The appendix is never mentioned and little is done in design terms to denote the term as something included in the glossary.

The focus on the critical yet subtle types of textual design important to technical communication offers another potential pedagogical opportunity. Students can work with these documents to suggest best design practices (e.g., emphasizing important pieces of text or terms in a glossary) for a professionally produced, real-world textual document. They can gain experience working with technical material that they might not fully understand but will still be able to engage with enough to apply the terms and theories they learn in the technical communication classroom.

DISCUSSION

The primary goal of this article is to focus on technical standards both as examples of technical communication and texts that have pedagogical potential. As this article has argued, standards are an important example of technical communication. They translate technical material from larger bodies to individual readers; they can be comprehensive documents that go through multiple iterations and involve multiple authors; they can target multiple audiences; and they involve detailed instructional content. They are important texts that can showcase the role technical writing plays as a discursive infrastructure that supports and shapes various higher-level practices.

As the data analysis showed, standards are also consequential, professionally produced texts that can be tools to let students work with and edit real-world technical material. The TDS that was the data source for this article is comprehensive and important for RFID adoption. However, the 126-page text also works as an example of the struggles organizations face when documents go through multiple iterations and when they do not necessarily rely on trained technical communicators to make texts more usable. The data analysis covered areas in which the TDS may be improved, but the primary purpose was not a critique of a single text. Rather, the purpose was to showcase the pedagogical potential of using technical standards in the technical communication classroom. As the data showed, students could use these texts to learn more about how technical standards shape practices while also using comprehensive editing and design skills to make suggestions (or follow through with changes) about issues of consistency, design, and textual markers. Unlike many proprietary technical documents or outward-facing documents that focus more on marketing content than technical content, technical standards provide an opportunity to give students to work with, understand, and potentially revise valuable, public-facing technical documentation.

The data presented here suggest pedagogical methods that could be used to introduce students to standards. While the data analysis focused on one specific standard and I make no claims to broader generalizability, students could analyze different standards to identify similar issues. For example, technical editing assignments could have students work with different standards to identify the categories discussed above. The assignment might take a multi-section standard and have students analyze issues of authorial inconsistency found across the documents. The ability to identify inconsistencies across sections would enable students to move to a more comprehensive form of editing that moves past grammar to look for more fundamental-style questions that may inhibit readability.

The editing could also help students understand how inconsistencies can make instructional material less clear. As identified above, a standard like the TDS includes multiple formats for instructional content, which can make it difficult for the reader. Students could work with a standard to improve inconsistencies, identify different formats for instructions, identify audiences, and make design suggestions. For example, as the data analysis showed, the design of the TDS was fine, but the text lacked design elements such as contrast and emphasis that could help aid the reader. Students familiar with basic technical communication theory could apply that theory to standards as a way to work with and make suggestions about real-world text. The comprehensive editing work could then result in a suggestions report on how the standard under study could be improved as well as a comprehensive style guide for future documents. The project would then serve three purposes: 1) It would help students understand the role technical writing plays in shaping how objects are built and practices are designed, 2) Students would be able to work with and comprehensively edit large, real-world, technical documents, and 3) Students would become more familiar with the genre of standards and be better prepared to work with standards as they enter the workforce.

One of the most valuable pieces of positioning technical standards as texts with pedagogical potential is their availability. Not all standards are freely available, though some are and others are available through university subscription. Consequently, to help further the argument that technical standards should be taught in the technical communication classroom, the list below covers where to find standards and whether subscriptions are required. This list is intended to help technical communication instructors and practitioners interested in developing standards expertise, and, while it is not comprehensive, it provides ample resources.

- **GS1:** GS1 is an international organization that produces standards about business communication and identification. It is responsible for various standards related to barcodes and RFID technology. The organization's recently published standards are freely available and can be found here: https://www.gs1.org/standards/log
- **International Organization for Standardization (ISO):** The ISO is an international organization that includes members from various standards-setting organizations. It is one of the most powerful standards-setting bodies and has published 22,432 international standards as of December 2018. The ISO website also has extensive information about the standards development process. The ISO charges for access to its standards, but it does have freely available standards on its "Popular Standards" page: https://www.iso.org/popular-standards.html
- **International Telecommunication Union (ITU):** The ITU is a UN agency responsible in part for global telecommunication standards. The ITU website includes various free standards recommendations governing everything from allocation of the radio spectrum to standards about video calling. The freely available standards can be found here: https://www.itu.int/itu-t/recommendations/index.aspx
- **ASTM International:** ASTM has published more than 12,000 technical standards covering industries such as oil & gas, aerospace, and agriculture. ASTM does charge for access to its published standards, but some universities have access to all of the standards through the library electronic databases. **https://www.astm.org/**
- **Society for Standards Professionals (SES):** The SES does not publish its own standards, but the website is a valuable resource for people interested in pursuing standards-writing as a career. The website includes lists of international standards-setting bodies and a certification program students and technical communication practitioners could pursue to learn more about the standards process. https://www.ses-standards.org/

The five sources above are not meant to be a comprehensive account of standards-setting bodies. They all offer resources instructors can use to teach students about standards as a form of technical communication. Some of those resources (e.g., ISO and ITU) also walk people through the standards-setting process, so students can be introduced to how writing by committee works in practice. The freely available technical documents on each of those sites provides pedagogical opportunities to let students work with real-world texts, and the experience they gain would be relevant whether they pursued a career in standards-writing or another technical communication field.

LIMITATIONS AND FUTURE RESEARCH

I did an in-depth analysis of one long standard rather than a more cursory analysis of multiple standards. Consequently, the results reported upon are not generalizable. I make no claims that all standards face similar issues, though the TDS is published by one of the major business standards organizations; it is not just a random standard chosen as an object of study. Future research studies can examine other major standards to establish if there are consistent issues that can be improved. The diversity of available standards also adds to their pedagogical value. Students could compare standards from different organizations to note similarities and differences within the broader genre.

Ultimately, treating standards as technical communication opens up a potentially rich vein of future research opportunities. Technical communication researchers can focus on establishing the genre elements of standards, establishing consistent guidelines and best practices, and working with users to improve the standards process. Researchers also could do workplace research with practitioners to examine how standards shape the work of technical communicators. The pedagogical opportunities are possibly more pronounced. Thousands of publicly available standards exist that can be used to teach students about an important genre of technical communication. Even if the students do not pursue careers in standards writing, standards are a diverse enough genre to include various elements of technical communication, including definition, documentation, and test procedures that would be valuable in the classroom.

CONCLUSION

Standards are important. They are the discursive infrastructure upon which much of our world is built. Looking up information online involves engaging, often unknowingly, with standards that govern everything from identification practices to the size of cables running through the ground. Driving to work involves confronting multiple standards that shape everything from the design of stop signs to the ISO 26262 standard that governs automobile safety. Standards are everywhere, and somewhere there are written documents that undergird many of our interactions with the material world.

Standards are also prime examples of technical communication. They can work as extended procedural documents designed to bring consistency to the shaping of material things. As examples of technical communication, these standards have pedagogical value in the technical communication classroom. They are technical documents used across various industries, and, most practically, they are available to instructors who want to find technical texts to show students how written language shapes the world.

I want to conclude here by reiterating a few main points about standards that can showcase their pedagogical value. First, they are technical documents that have varied audiences but expect a moderate level of technical literacy. Second, they are not legally binding but shape objects and practices because they are adopted willingly and should be accessible to spur adoption. Third, they are often comprehensive and can range from a few pages to well over 100 pages. Fourth, many standards are freely available. And, finally, standards are found in almost any industry. Consequently, standards have significant pedagogical potential for the technical communication classroom. Students can analyze and comprehensively edit standards from relevant industries and gain experience working with real-world technical texts. As an additional benefit, students will also become more familiar with a genre they will likely engage with in their jobs. These standards are exactly the type of oft-ignored but nonetheless crucial forms of work that have shaped our profession and discipline. They are technical communication.

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Manuscript received 5 September 2018, revised 1 December 2018; accepted 21 January 2019.